INTERNATIONAL STANDARD

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Dentistry — Casting investments and refractory die materials

Art dentaire — Revêtements et matériaux pour modèles réfractaires

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 15912 was prepared by Technical Committee ISO/TC 106, *Dentistry*, Subcommittee SC 2, *Prosthodontic materials*.

This first edition of ISO 15912 contains the requirements and test methods for dental casting, brazing and refractory investment and die materials. It cancels and replaces ISO 7490:2000, ISO 9694:1996, ISO 11244:1999, ISO 11245:1999 and ISO 11246:1996.

In general, this International Standard contains the same or similar requirements to those contained in the five International Standards it replaces. An exception is the requirement for setting expansion, which has been removed due to the continuing inability to find a suitably reliable and reproducible test method for all binder chemistries.

Introduction

Dental investment and other refractory materials are used for a variety of applications within the dental laboratory. Historically, standards were developed on the basis of the chemistry of the binding system used or specific type of application, resulting in five separate International Standards. This single International Standard gives the requirements and test methods for dental casting, brazing and refractory investments and refractory die materials, regardless of the nature of the binding system or the particular application.

This International Standard classifies investments into types according to their intended use and classes according to the recommended burn-out procedure.

A specific quantitative requirement for setting expansion is not included in this International Standard. However, if the setting expansion of a gypsum-bonded investment is measured, use of the procedure contained in ISO 6873:1998 should be considered. This procedure is not recommended for phosphate-bonded products.

Dentistry — Casting investments and refractory die materials

1 Scope

This International Standard is applicable to dental casting, brazing and refractory investments and refractory die materials, regardless of the nature of the binding system or the particular application.

This International Standard classifies investments into types according to their intended use and classes according to the burn-out procedure recommended by the manufacturer.

This International Standard specifies requirements for the essential physical and mechanical properties of the materials and the test methods used to determine them.

This International Standard also includes requirements for the information and instructions which accompany each package.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 3696:1987, *Water for analytical laboratory use — Specification and test methods*

ISO 1942, *Dentistry — Vocabulary*

ISO 8601, *Data elements and interchange formats — Information interchange — Representation of dates and times*

3 Terms and definitions

For the purposes of this document, the terms and definitions of ISO 1942 and the following apply.

3.1
dental casting investment material
refractory filler powder and binder system which, mixed with a specified liquid, hardens to form the mould for casting dental restorations

NOTE Generally, the refractory powder consists of oxides such as silica. Depending upon its chemistry, all the components of the binder can be in the liquid, or some can be dispersed (as a powder) in the refractory powder. The liquid can be pure water or a special liquid, as required by the chemistry of the binding system.

3.2
refractory die material
powder mixture of a refractory filler and binder system designed, specifically (when mixed with a particular liquid) to allow the formation of a hardened die suitable for the production of dental ceramic restorations using the sintering technique

3.3
brazing investment material
powder mixture of a refractory filler and binder system, designed specifically (when mixed with a particular liquid) to allow the formation of a cast upon which components are held in place while they are being joined by brazing

NOTE The cast can be referred to as the model, even though this is a deprecated term.

3.4
special liquid
liquid, other than water, supplied by the manufacturer or distributor for mixing with the investment powder

3.5
slow- or step-heating method
heating method in which the burn-out furnace is initially at room temperature, then its temperature is increased to the end temperature at a programmed rate

NOTE After a time recommended by the manufacturer, the set investment is placed in the burn-out furnace, which is set at room temperature. The temperature of the furnace is then increased to the end temperature in a series of stages and at a rate recommended by the manufacturer.

3.6
quick-heating method
heating method in which the burn-out furnace is set initially at the recommended final burn-out temperature

NOTE At a time recommended by the manufacturer, the set investment is placed directly in the heated furnace. The furnace is maintained at this temperature,

4 Classification

For purposes of this International Standard, investments and refractory die materials are categorized by the following types.

— Type 1: for the construction of inlays, crowns and other fixed restorations;

— Type 2: for the construction of complete or partial dentures or other removable appliances;

— Type 3: for the construction of casts used in brazing procedures;

— Type 4: for the construction of refractory dies.

There are two classes of casting investment and refractory die material:

— Class 1: recommended for burn-out by a slow- or step-heating method;

— Class 2: recommended for burn-out by a quick-heating method.

5 Requirements

5.1 General

If a manufacturer claims that a given product is suitable for both classes, the material must satisfy the requirements for both classes.

5.2 Material consistency

When examined in accordance with 7.1, the powder shall be uniform and free from lumps and foreign matter. If a special liquid is supplied, it shall be free of sediment.

5.3 Fluidity

When measured in accordance with 7.2, the fluidity shall not vary by more than 30 % from the value stated by the manufacturer.

This requirement shall not apply to silica bonded investments (i.e. products in which an alcoholic solution of ethyl silicate is used in the binding system).

5.4 Initial setting time

When measured in accordance with 7.3, the initial setting time shall not vary by more than 30 % from that stated by the manufacturer. If the manufacturer gives a range for the initial setting time, the measured initial setting time shall not vary by more than 30 % from the mid-point of this range.

5.5 Compressive strength

When measured in accordance with 7.4, the compressive strength shall not vary by more than 30 % from that stated by the manufacturer and in no case shall be lower than 2 MPa.

5.6 Linear thermal dimensional change

When measured in accordance with 7.5, the linear thermal expansion for all four types shall not vary by more than 20 % from the value stated by the manufacturer. If the manufacturer gives a range for the linear thermal expansion, the measured linear thermal expansion shall not vary by more than 20 % from the mid-point of this range.

When measured in accordance with 7.5, the linear firing shrinkage for Type 4 shall not vary by more than 15 % from the value stated by the manufacturer. If the manufacturer gives a range for the linear firing shrinkage, the measured linear firing shrinkage shall not vary by more than 15 % from the mid-point of this range.

5.7 Setting expansion

See the Introduction for guidance on setting expansion.

6 Sampling, test conditions and mixing

6.1 Sampling

Use material from a single lot. Use only sealed, undamaged packages that are within the “use before” date.

If a special liquid is recommended by the manufacturer, use liquid from a single lot that is within the “use before” date.

6.2 Test conditions

Carry out all testing under controlled conditions of temperature (23 ± 1) °C and relative humidity (50 ± 10) % in a room free from obvious draughts.

Hold all materials and test equipment under these controlled conditions for a minimum period of 16 hours prior to testing.

6.3 Mixing

Mix according to the manufacturer's instructions. If a range is given for the powder to liquid ratio, use the midpoint of this range. When a special liquid is supplied, use at the manufacturer’s recommended dilution in accordance with 8.1 c). If a range of dilutions is given, use the mid-point of this range. If water is required, use water that complies with grade 3 in accordance with ISO 3696:1987.

6.3.1 Apparatus

The following items may be needed, depending on the manufacturer's instructions.

6.3.1.1 Clean, dry flexible **mixing bowl** and rigid **spatula** for hand mixing.

6.3.1.2 **Mechanical/vacuum mixer** with an appropriate clean and dry mixing bowl.

6.3.1.3 **Timer** capable of measuring time to an accuracy of 1 s.

6.3.2 Procedure

Measure the required mass of powder and the recommended volume of liquid to an accuracy of 1 %.

Pour the liquid into the mixing bowl (6.3.1.1) and add the powder. Commence timing when liquid and powder make first contact.

Hand spatulate (6.3.1.1) and/or mix mechanically (6.3.1.2) (with a vacuum, if specified) for the appropriate length of time, according to manufacturer's instructions. If the manufacturer recommends a range of mixing times, the mid-point of the range shall be used.

7 Test methods

7.1 Material consistency

7.1.1 Testing procedure

Examine the material, as received, visually without the aid of magnification. Use eyesight of nominally normal visual acuity. Corrective (non-magnifying) lenses may be worn.

7.1.2 Test report

Report whether the product meets or does not meet the requirement for material consistency (5.2). If it does not meet the requirement for material consistency, state the reason.

7.2 Fluidity

7.2.1 Material and apparatus

7.2.1.1 **Clean dry cylindrical ring mould**, of length (50 ± 1) mm, of inside diameter (35 ± 1) mm and constructed from a corrosion-resistant, non-absorbent material.

7.2.1.2 **Flat square glass plate**, measuring at least 150 mm × 150 mm.

7.2.1.3 **Dental vibrator**.

7.2.1.4 **Scale or rule**, graduated in millimetres.

7.2.1.5 **Mould-release agent**, such as silicone spray or silicone grease.

7.2.2 Number of specimens

Make 2 specimens from separate mixes of investment.

NOTE Three more specimens (from three mixes of investment) are required if one specimen meets the requirement of 5.4 and the other does not.

7.2.3 Testing procedure

Coat the inside of the ring mould (7.2.1.1) with a thin layer of mould release agent (7.2.1.5).

Mix the investment according to 6.3, using a mass of powder with the appropriate volume of liquid that will produce a workable mix sufficient to fill the mould. Centre the mould base on the glass plate and place the plate on the dental vibrator platform. Vibrate the investment mix into the mould until it is slightly overfilled. Vibrate for (20 ± 2) s. Level the mix flush with the top of the mould. 2 min after the first contact of powder and liquid, lift the mould vertically from the plate in a smooth action over a period of 5 s, to allow the mix to slump onto the plate. As soon as the mixed investment has set, measure the largest and smallest diameters of the set investment base, and record the average value.

Repeat the test and record this second value, the average of the two measurements made on the second specimen.

7.2.4 Evaluation of results

If both results meet the requirement of 5.3, the product complies.

If neither result meets the requirement of 5.3, the product fails to comply.

If one test result meets this requirement and one fails to do so, repeat the test three more times.

If the results of all three of these additional tests meet the requirement of 5.3, the product complies. Otherwise, it fails to comply.

7.2.5 Test report

The test report shall contain the following information:

a) the average value for every test conducted in accordance with 7.2.3 and 7.2.4;

b) the value for the fluidity given by the manufacturer in accordance with 8.3.2 a);

c) a statement that the product meets or does not meet the requirement for fluidity of 5.3.

7.3 Initial setting time

7.3.1 Material and apparatus

7.3.1.1 Needle penetrometer apparatus, an example of which is shown in Figure 1, and which meets the following requirements:

a) needle, 50 mm long, of circular cross section and with a diameter of (1,00 ± 0,01) mm;

b) rod of approximate dimensions 270 mm in length and 10 mm in diameter;

c) total mass of the needle, rod and compensating weight of (300 ± 1) g;

d) scale graduated in millimetres;

e) base plate of plate glass, measuring about 100 mm × 100 mm.

7.3.1.2 Clean, dry conical ring mould, constructed from a corrosion-resistant, non-absorbent material, with an inside diameter of 70 mm at the top and 60 mm at the base, and a height of 40 mm.

7.3.1.3 Mould release agent, such as silicone spray or silicone grease.

7.3.2 Number of specimens

Make two specimens from separate mixes of investment.

NOTE Three more specimens (from three mixes of investment) are required if one specimen meets the requirement of 5.4 and the other does not.